SOME ALGAE FROM THE OHIO RIVER DRAINAGE BASIN

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INTRODUCTION

Studies are being conducted at the Robert A. Taft Sanitary Engineering Center on the algae of importance in water supply, sewage treatment, and stream pollution. In the course of these studies, a number of algae of particular interest both in sanitary biology and as species records have been encountered in the Ohio River drainage basin. Some of the algae included in this paper are those which are little known or infrequently reported from this area and for which additional records would be useful. Others are reported because they have been found growing in unusual environmental situations. One such habitat was the trickling filters in the Fairmount Sewage Treatment Plant, Dayton, Ohio. A year-long study of the algal and fungal populations of these filters showed that algal growth was abundant on the surface slag rocks throughout the year (Cooke and Hirsch, 1958).

Other algae discussed in this paper were found during a recent study of the plankton and bottom algae of the Scioto River. In a previous study of the river, Kehr et al (1941) observed that the plankton organisms were far in excess of those of previously studied rivers, both in numbers of species and numbers of organisms present. The species discussed here are ones not reported from this previous study. Additional algae listed here were collected from Lytle Creek. The effects of organic pollution from the effluent of the Wilmington, Ohio, primary sewage treatment plant on the fauna of this small stream have been studied and reported (Gaufin and Tarzwell, 1952, 1955, and others). The activated sludge treatment process was added to the plant in 1954, and this has changed the nature of the effluent and thus of the habitat downstream since the algae were collected. Still other algae represent collections made from lakes, ponds, and streams and a sewage treatment plant on the Ohio river drainage basin.

Fourteen of the algae are listed primarily because they represent species in the region from which unialgal cultures have been obtained. These cultures are among those which have been used at the Center in experiments on potential algicides (Foter, et al, 1953; Palmer and Maloney, 1955; Maloney and Palmer, 1956; Maloney, 1958) and taste and odor research (Palmer, 1952, and Palmer and Maloney, 1953). Species which at present can be grown readily in culture tend to be those which are common inhabitants of the flora and are not very specific in their nutritional requirements. The cultures referred to were isolated from algae collected from natural waters in southeastern Ohio and from aquaria kept indoors at the Sanitary Engineering Center in Cincinnati.

THE OHIO JOURNAL OF SCIENCE 58(6): 375, November, 1958.

List of Algae

The algae referred to in this report are as follows:

Myxophyceae
- *Agmenellum thermale*
- *Amphithrix janthina*
- *Anacystis cyanea*
- *Anacystis montana*
- *Calothrix parietina*
- *Fremyella diplosiphon*
- *Gomphosphaeria wichurae*
- *Hapalosiphon fontinalis*
- *Oscillatoria curviceps*
- *Oscillatoria princeps*
- *Oscillatoria tenuis*
- *Phormidium uncinatum*
- *Plectonema nostocorum*
- *Symploca erecta*

Rhodophyceae
- *Audouinella leibeinii*
- *Thorea andina*

Chlorophyceae
- *Ankistrodesmus falcatus*
- *Ankistrodesmus falcatus* var. *acicularis*
- *Chlamydomonas communis*
- *Chlamydomonas paradoxa*
- *Chlorotylium mammiforme*
- *Oocystis lacustris*
- *Oocystis marssonii*
- *Scenedesmus obliquus*
- *Stigeoclonium nanum*
- *Tetraspora gelatinosa*
- *Ulothrix tenuissima*

Euglenophyceae
- *Euglena mutabilis*
- *Lepocinclis ovus*

Xanthophyceae
- *Centritractus belonophorus*

Bacillariophyceae
- *Achnanthes linearis*
- *Biddulphia laevis*
- *Cymbella microcephala*
- *Gomphonema parvulum*
- *Melosira crenulata* var. *tenuis*
- *Nitzschia palea*
- *Rhoicosphenia curvata*

Herbarium specimens of all these algae except for *Euglena*, *Lepocinclis*, and *Centritractus* are on file in the collections of the Chicago Natural History Museum.

Information on Each Species

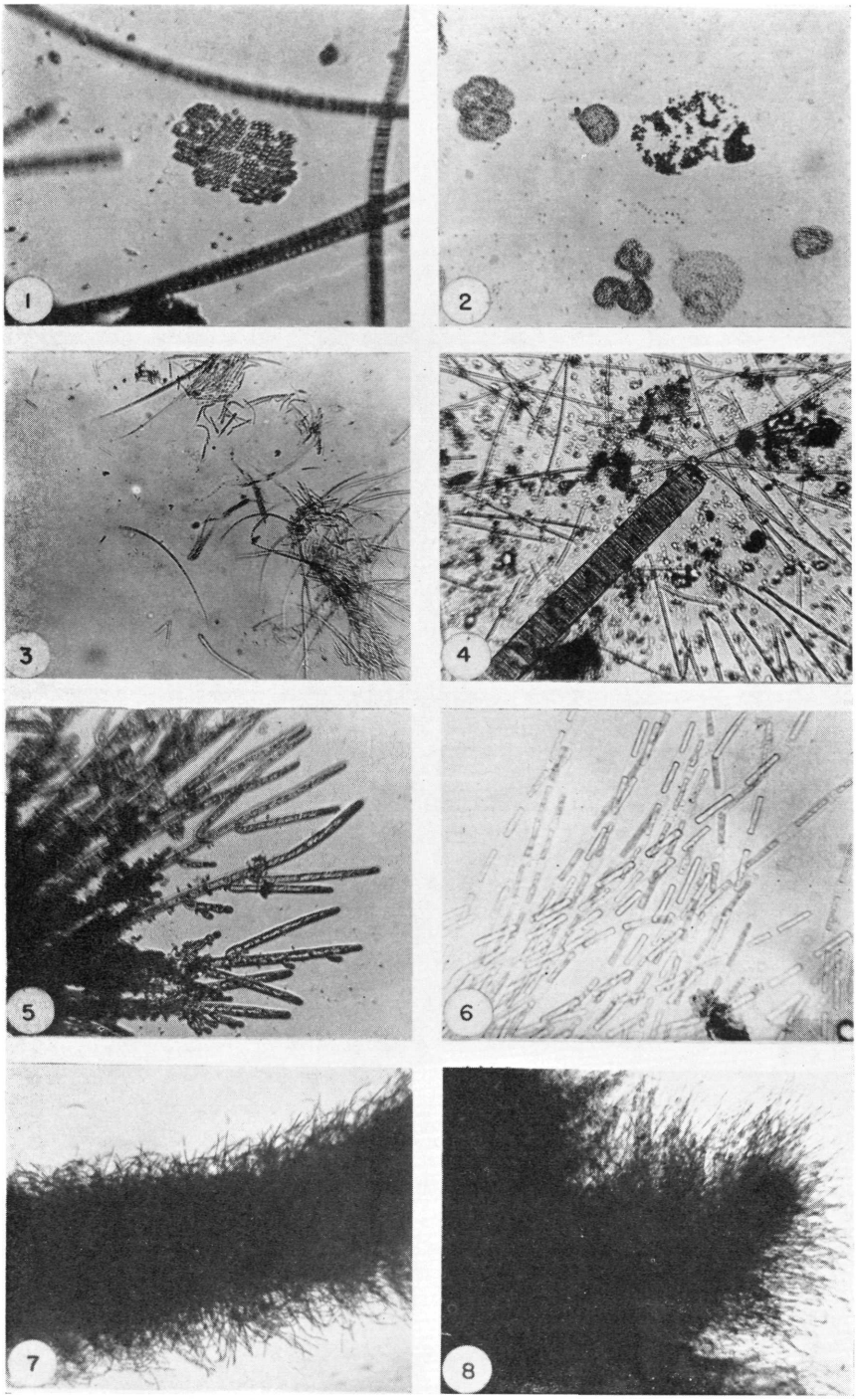
Agmenellum thermale (*Kütz.*) *Dr. and Daily. Figure 1.*—Big Sandy River, Catlettsburg, Boyd County, Kentucky. Collected by C. M. Palmer, September 25, 1955. Identification by F. Drouet. Mixed with *Oscillatoria curviceps* which formed a surface "bloom" in pool just above dam.

Amphithrix janthina (*Mont.*) *Born. and Flah.*—Fairmount Sewage Treatment Plant, Dayton, Montgomery County, Ohio. Collected by A. Hirsch and Wm. Bridge Cooke, November 21, 1955. Identification by F. Drouet. Found on trickling filters throughout the year, entangled among other algae. Generally forming small, dense, blue-green clumps. Drouet (written communication, February 7, 1956) describes this form as being ". . . with often curved and branched filaments instead of the upright and parallel filaments one reads of in the descriptions and sees in the illustrated manuals; this 'atypical' habit is characteristic of this species in habitats where other algae have overgrown it . . . the larger trichomes here have been distinguished by the name var. *torulosa* (Grun.) Born. and Flah., but the larger and smaller trichomes appear to me to have a common origin."

EXPLANATION OF FIGURES ON PLATE I

All Figures magnified x 100 except figures 7 and 8

1. *Agmenellum thermale* (Kütz.) Dr. and Daily
2. *Anacystis cyanea* (Kütz.) Dr. and Daily (upper right) and *Gomphosphaeria wichurae* (Hilse) Dr. and Daily
3. *Calothrix parietina* Born. and Flah.
4. *Oscillatoria princeps* Vauch. (single large filament) and *Oscillatoria tenuis* Ag.
5. *Audouinella leibleinii* (Israels.) C. M. Palmer, N. Comb.
6. Radiating surface hairs of *Thorea andina* Moeb. and Lagerh.
7. Portion of thallus of *Thorea andina* Moeb. and Lagerh. (x 20)
8. Young branch of thallus of *Thorea andina* Moeb. and Lagerh. (x 40)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Anacystis cyanea (*Kütz.*) *Dr. and Daily. Figure 2.*—Stonelick Lake, Clermont County, Ohio. Collected by C. M. Palmer and T. E. Maloney, October 19, 1951. Mixed with *Gomphosphaeria wichurae* and others which formed an extensive "bloom" up to 2 inches thick on the surface of the lake.

Anacystis montana (*Lightf.*) *Dr. and Daily.*—Fairmount Sewage Treatment Plant, Dayton, Montgomery County, Ohio. Collected by A. Hirsch and Wm. Bridge Cooke, November 24, 1955. Identification by F. Drouet. Found growing among other algae, on those filters with intermittent flow of sewage, which shut off every night. Not found on filters with continuous flow.

Calothrix parietina *Born. and Flah. Figure 3.*—Aquarium in laboratory, Cincinnati, Hamilton County, Ohio. Isolated by C. M. Palmer from mixed growth as unialgal culture from which herbarium mounts were prepared, July 10, 1950. Identification by F. Drouet.

Fremyella diplosiphon (*Born. and Flah.*) *Dr.*—Aquarium in laboratory, Cincinnati, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which the herbarium mounts were prepared, July 24, 1950. Identification by F. Drouet.

Gomphosphaeria wichurae (*Hilse*) *Dr. and Daily. Figure 2.*—Stonelick Lake, Clermont County, Ohio. Collected by C. M. Palmer and T. E. Maloney, October 19, 1951. Identification by F. Drouet. Forming an extensive, dense blue-green "bloom" up to two inches thick on the lake. Producing a strong grassy odor. Mixed with smaller amounts of *Anacystis, Aphanizomenon, Anabaena, Trachelomonas,* and *Navicula.*

Hapalosiphon fontinalis (*Ag.*) *Born.*—Devou Lake, Covington, Kenton County, Kentucky. Collected by C. M. Palmer, October 31, 1955. Identification confirmed by F. Drouet. Found as blue-green cushionlike patches attached to bottom of glass in bottle of water which had been collected from Devou Lake on July 12, 1955, by R. Bordner, and had remained indoors since then.

Oscillatoria curviceps *Ag.*—Big Sandy River, Catlettsburg, Boyd County, Kentucky. Collected by F. Middleton, August 19, 1955, and by C. M. Palmer, September 25, 1955. Identification by F. Drouet. Forming a bubbly green surface "bloom" in pool just above dam.

Oscillatoria princeps *Vauch. Figure 4.*—Setter's pond, Cincinnati, Hamilton County, Ohio. Collected by H. Braus, August 13, 1950. Identification confirmed by F. Drouet. Material is giant size, the filaments when fresh, measuring up to 90 μ in diameter. These large filaments of *O. princeps* have been characterized as forma *maxima* (Kütz.) Rab. (Prescott, 1942).

Oscillatoria tenuis *Ag. Figure 4.*—Lytle Creek at Ogden, Clinton County, Ohio. Collected by C. M. Palmer, August 10, 1950. Identification by F. Drouet. Forming large, fragile, blue-green floating mats in quiet water areas at side of stream.

Phormidium uncinatum (*Ag.*) *Gom.*—Fairmount Sewage Treatment Plant, Dayton, Montgomery County, Ohio. Collected by A. Hirsch and Wm. Bridge Cooke, December 12, 1955. Identification by F. Drouet. Became abundant on trickling filters in May and found growing there through following winter. Forming dense brown or blackish-green pad on the rocks, often overgrowing other algae.

Plectonema nostocorum *Born.*—Meadville, Crawford County, Pennsylvania. Collected by W. M. Ingram, August 10, 1955. Identification by F. Drouet. Found on side of unused secondary settling tank of activated sludge sewage treatment installation, forming an extensive, velvety mat, about 1 cm thick. Exposed portion black-blue-green, portion below surface much lighter in color.

Symploca erecta *Pevalec.*—Aquarium in laboratory, Cincinnati, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which herbarium mounts were prepared July 25, 1950. Considered by F. Drouet to be *Plectonema nostocorum.* It is reported here as *Symploca erecta* because the growth has persistently developed the erect tufts which serve to characterize and to distinguish this genus.

Audouinella leibleinii (*Israels.*) *C. M. Palmer, N. Comb. Figure 5.*—Syn.: *Chantransia leibleinii* Kütz., Phyc. germ. p. 229, 1945; *Pseudochantransia chalybaea* var. *leibleinii* (Kütz.) Rab., Krypt.-Fl. 2: 115, 1847; *Pseudochantransia leibleinii* (Kütz.) Israels., Symbol. Bot. Upsal. 6 (No. 1): 58, 1942.

Scioto River, Ross County, Ohio. Collected by C. Henderson and C. M. Tarzwell, September 28, 1953, and in Scioto River, Pike County, September 24, 1953. Found in riffles.

Some authorities list this growth as the juvenile stage of a *Batrachospermum*. The material from the Scioto River is considered to be in its mature condition and not the juvenile stage of another alga. For this reason it is placed in the genus *Audouinella* which according to Papenfuss (1945) should replace the name *Chantransia* for the fresh-water forms.

Thorea andina *Moeb. and Lagerh. Figures 6, 7, 8.*—Scioto River, Piketon, Pike County, Ohio. Collected by A. Hirsch and C. M. Palmer, October 22, 1953.

Found in riffle. One species (*T. ramosissima*) of this rare genus was previously reported in Ohio from Cincinnati (Kellerman and Werner, 1893) and from Sandusky Bay (Riddle, 1903). Only two pieces of the thallus were found in present collection. Larger piece is 13 cm long with about 50 branches, 1 to 10 mm long; smaller piece is 6 cm long with numerous branches especially near base. No main axis evident in either piece. Much of thallus is approximately 1 mm in diameter, including radiating hairs; central strand of longitudinal filaments alone is approximately 0.5 mm in diameter. Originally, color black to naked eye, with a purplish marginal tinge; appearing brown under 6 x magnification, with light purple hairs covering surface. Color after drying and storing, tan to olive green, in both dry and wet condition.

Ankistrodesmus falcatus (*Corda*) *Ralfs.*—Fish hatchery pond at Newtown, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which herbarium mounts were prepared, August 28, 1950.

Ankistrodesmus falcatus *var.* acicularis (*A.Br.*) *G. S. West.*—Fish hatchery pond at Newtown, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which herbarium mounts were prepared, July 27, 1950.

Chlamydomonas communis *Snow.*—Fish hatchery pond at Newtown, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which herbarium mounts were prepared, July 27, 1950.

Chlamydomonas paradoxa *Pasch.*—Pond on Losantiville Avenue, Cincinnati, Hamilton County, Ohio. Collected by H. Braus, August 14, 1950. Isolated by C. M. Palmer as unialgal culture, from which herbarium mounts were prepared.

Chlorotylium mammiforme (*Babbis*) Kütz.—Small stream west of Devou Park, Covington, Kenton County, Ky. Collected by C. M. Palmer and T. E. Maloney, May 14, 1952. Forming a bright green growth on rocks. This material does not show the zonate growth characteristic of *Chlorotylium cataractarum* Kütz., a species previously reported from Kentucky (Collins, 1909).

Oocystis lacustris *Chodat. Figure 18.*—Lytle Creek at Ogden, Clinton County, Ohio. Collected by A. Gaufin, August 1, 1950. Isolated by C. M. Palmer as unialgal culture from which the herbarium mounts were prepared. Found 4.8 stream miles below the entrance of organic pollution from the Wilmington Sewage Treatment Plant. Clean-water zone during the summer and recovery zone during the winter.

Oocystis marssonii *Lemmerm.*—Fish hatchery pond at Newtown, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which herbarium mounts were prepared August 28, 1950.

Scenedesmus obliquus (*Turpin*) *Kütz.*—Fish hatchery pond at Newtown, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which herbarium mounts were prepared July 27, 1950.

Stigeoclonium nanum *Kütz.*—Lytle Creek, Clinton County, Ohio. Collected by G. H. Paine, March 22, 1951. Identification by G. W. Prescott. Found attached to igneous rocks in riffle. Growing in association with *Ulothrix tenuissima*, 2 stream miles below entrance of organic pollution from the Wilmington Sewage Treatment Plant.

Fairmount Sewage Treatment Plant, Dayton, Montgomery County, Ohio. Collected by A. Hirsch and Wm. Bridge Cooke, November 21, 1955. Identification by G. W. Prescott. On trickling filters, growing in association with other algae, including *Ulothrix tenuissima.*

Fish hatchery pond at Newtown, Hamilton County, Ohio. Collected by C. M. Palmer, June 28, 1951. Identification by G. W. Prescott.

Lake at Burnet Woods, Cincinnati, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture October 3, 1950.

Tetraspora gelatinosa (*Vauch.*) *Desvaux. Figure 17.*—Lytle Creek at Ogden, Clinton County, Ohio. Collected by A. Gaufin and C. Howard, July 31, 1950. Growing on rocks in shallow riffle. (See *Oocystis lacustris* for note on habitat). An earlier collection from the

same location on July 19, 1950, represents younger material in a *Schizochlamys* stage, with dense, brownish caps outside of the protoplasts.

Ulothrix tenuissima *Kütz.*—Lytle Creek, Clinton County, Ohio. Collected by G. H. Paine, March 22, 1951. Identification by G. W. Prescott. Found attached to igneous rocks in riffle, growing in association with *Stigeoclonium nanum.* (See *S. nanum* for note on habitat).

Dayton Sewage Treatment Plant, Dayton, Montgomery County, Ohio. Collected by A. Hirsch and Wm. Bridge Cooke, November 21, 1955. Identification by G. W. Prescott. Found on rocks of trickling filter, growing in association with other algae, including *Stigeoclonium nanum.*

Euglena mutabilis *Schmitz and* Lepocinclis ovum (*Ehr.*) *Lemmerm.*—Snow Creek, Murray City, Hocking County, Ohio. Collected by Wm. Bridge Cooke, April 10, 1954. These two genera both abundant in creek with pH of about 4.0. Growing mixed with *Eunotia, Achnanthes,* and *Navicula.*

Centritractus belonophorus *Lemmerm.*—Scioto River, Pike County, Ohio. Collected by C. Henderson and C. M. Tarzwell, September 30, 1953. Also found by A. Hirsch in Scioto River in Franklin County and in the following tributaries of the Scioto during July 1954: Big Walnut Creek, Franklin County; Walnut Creek, Pickaway County; and Big Darby Creek, Pickaway County. Occurred infrequently in the plankton.

Achnanthes linearis (*W. Smith*) *Cleve. Figure 9.*—Fish hatchery pond, Newtown, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture, from which herbarium mounts were prepared July 27, 1950.

Biddulphia laevis *Ehr. Figures 13 and 14.*—Scioto River, Ross County, Ohio. Collected by C. Henderson and C. M. Tarzwell, September 23, 1953. Identification confirmed by P. S. Conger. Found a number of times in Scioto River in Ross and Pike Counties during fall of 1953 and summer of 1954, growing entangled among *Hydrodictyon, Cladophora* and other filamentous algae. Also infrequently in the plankton. Smith (1950) reports *B. laevis* as being found in Nebraska. P. S. Conger (written communication March 12, 1956) states that this species often occurs in great numbers, sometimes growing attached to rocks in rapid water.

Cymbella microcephala *Grun. Figure 10.*—Cowan Lake, Clinton County, Ohio. Collected by C. M. Palmer, August 29, 1950. Growing mixed with *Bulbochaete, Agmenellum, Staurastrum, Synedra, Cyclotella, Crucigenia,* and *Mougeotia,* on concrete wall, just below water surface.

Gomphonema parvulum (*Kütz.*) *Grun. Figure 16.*—Glass aquarium kept at 20° C. under artificial light in laboratory, Cincinnati, Hamilton County, Ohio. Isolated by C. M. Palmer as unialgal culture from which herbarium mounts were prepared July 24, 1950.

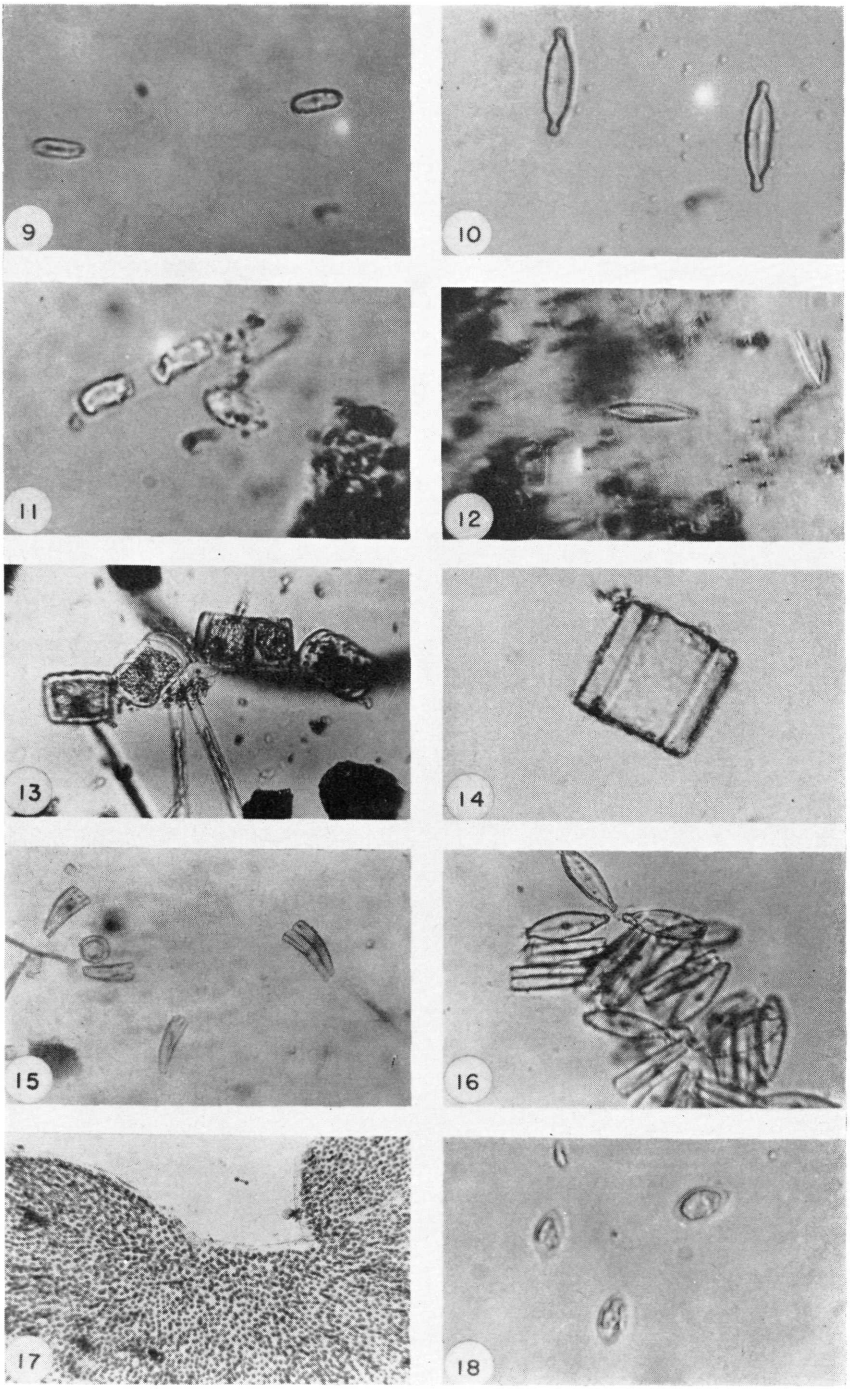
Melosira crenulata *Kütz. var.* tenuis (*Kütz.*) *Grun. Figure 11.*—Scioto River, Pike County, Ohio. Collected by A. Hirsch, May 19, 1954. Identification by P. S. Conger who describes this form (written communication November 4, 1955) as an ". . . exceptionally delicate variety. There is much question and uncertainty about this even in the books. Some make it *M. italica* O. Müll. var. *crenulata,* but that is merely synonymous and does not affect the identification." This form is illustrated in A. Schmidt Atlas d. Diatomaceenkunde, pl. 1, Figs. 53 or 56.

Collected by A. Hirsch a number of times in Scioto River in Franklin, Pickaway, Ross, and Pike Counties, Ohio, from February through September 1954. Also collected in the following tributaries of the Scioto during July 1954: Mill Creek, Delaware County; Olentangy River.

EXPLANATION OF FIGURES ON PLATE II

All figures magnified x 500 except figures 13, 14, 17, and 18

9. *Achnanthes linearis* (W. Smith) Cleve
10. *Cymbella microcephala* Grun.
11. *Melosira crenulata* Kütz. var. *tenuis* (Kütz.) Grun.
12. *Nitzschia palea* (Kütz.) W. Smith
13. Colony of *Biddulphia laevis* Ehr. (x 100)
14. Single cell, girdle view, of *Biddulphia laevis* Ehr. (x 200)
15. *Rhoicosphenia curvata* (Kütz.) Grun.
16. *Gomphonema parvulum* (Kütz.) Grun.
17. *Tetraspora gelatinosa* (Vauch.) Desvaux (x 100)
18. *Oocystis lacustris* Chodat (x 100)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Franklin County; Big Walnut Creek, Franklin County; Big Darby Creek, Pickaway County; Deer Creek, Ross County; Paint Creek, Ross County. A minute, very delicate diatom occurring in one, two, and occasionally three-celled chains. Extremely abundant in the river in May 1954, when its numbers were over 160,000 organisms per ml in the plankton, coloring the water brown. Also common as a bottom alga at that time, forming a brown slime on sheltered sand bars, where it was growing in association with *Nitzschia*, *Cyclotella*, and other diatoms.

Nitzschia palea (*Kütz.*) *W. Smith*. *Figure 12*.—Fairmount Sewage Treatment Plant, Dayton, Montgomery County, Ohio. Collected by A. Hirsch and Wm. Bridge Cooke, October 17, 1955. Identification by P. S. Conger (written communication November 4, 1955) who describes this form as ". . . probably a *Nitzschia palea* (Kütz.) W. Sm. or *N. Kützingiana* Hilse which is very close, perhaps a variety of the former." Found on trickling filters throughout the year, forming brownish slime or scattered among other algae.

Lytle Creek, at Ogden, Clinton County, Ohio. Collected by C. M. Palmer, August 7, 1950, and T. E. Maloney, February 28, 1952. Isolated by C. M. Palmer as unialgal culture (See *Oocystis lacustris* for note on habitat).

Rhoicosphenia curvata (*Kütz.*) *Grun*. *Figure 15*.—Seven Mile Creek north of Hamilton, Butler County, Ohio. Collected by C. M. Palmer, May 28, 1953. Identification confirmed by P. S. Conger.

ACKNOWLEDGMENTS

The writers express their gratitude to Mr. Paul S. Conger, U. S. National Museum; Dr. Francis Drouet, Chicago Natural History Museum; and Dr. Gerald W. Prescott, Department of Botany, Michigan State University, for aid in identification of a number of the algae. Appreciation is also expressed to Dr. Robert E. Stevenson of the Robert A. Taft Sanitary Engineering Center for assistance with the photomicrography, and to Drs. William M. Ingram and Wm. Bridge Cooke of the center for suggestions in the preparation of the manuscript.

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